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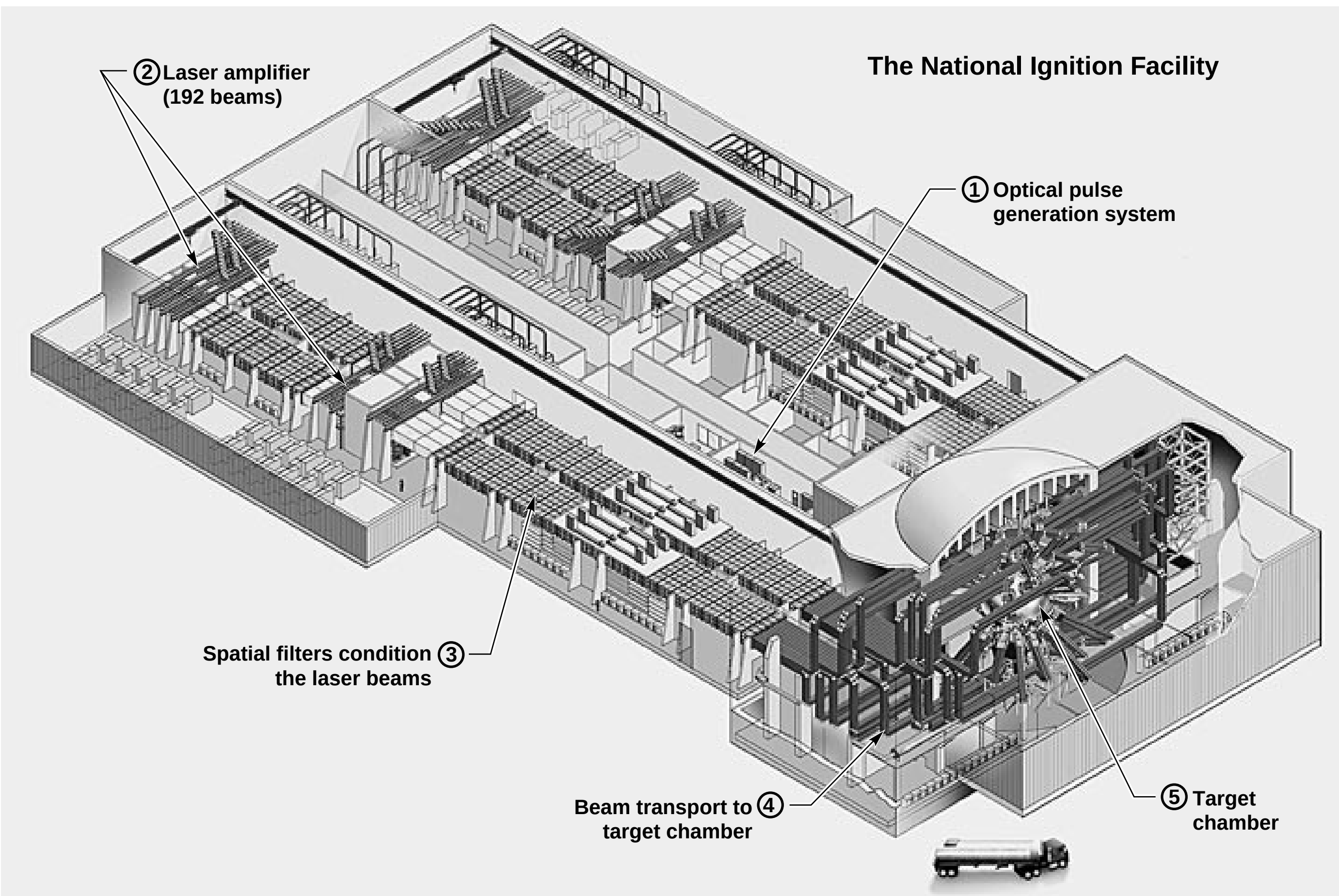
NIF NEWS
SPECIAL EDITION
THE NATIONAL IGNITION FACILITY NEWSLETTER

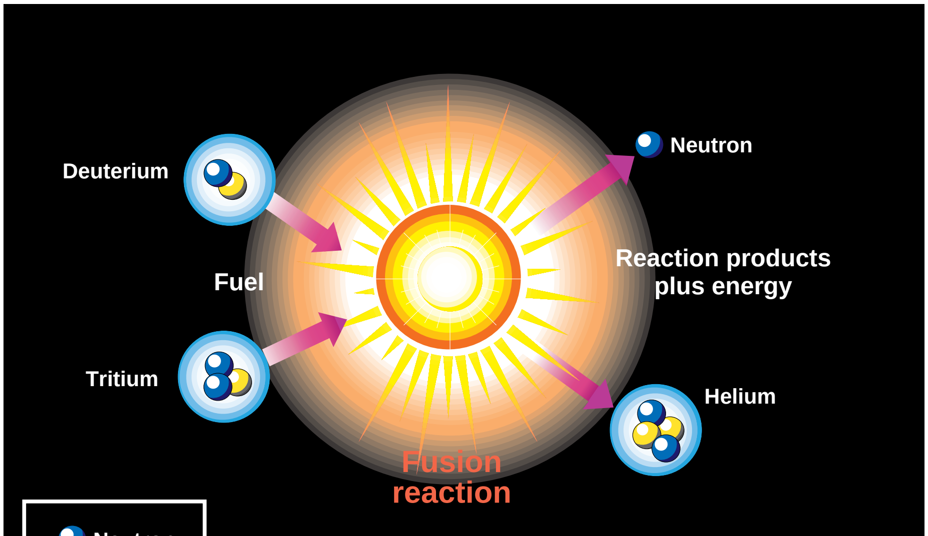
A Star Is Born

The Sun and the stars are natural fusion "power plants" that produce more energy than they consume, called *energy gain*. Scientists anticipate using the National Ignition Facility to achieve the long-sought goal of producing—for the first time in a laboratory—net energy gain from fusion ignition.

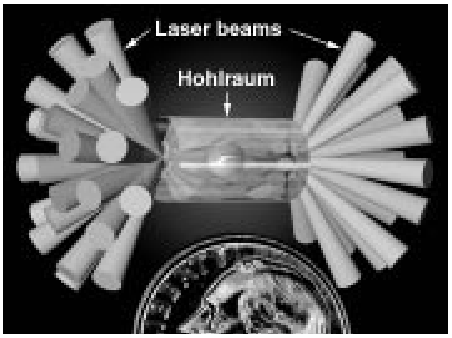


The heart of the National Ignition Facility (NIF) is a powerful laser whose energy will "ignite" small targets filled with fusion fuel. The NIF will (1) generate beams of laser light that are (2) amplified successively to greatly increase their energy, (3) conditioned to obtain the desired optical characteristics, and (4) transported through large beam tubes to a (5) target chamber, where the laser energy will begin the fusion process.

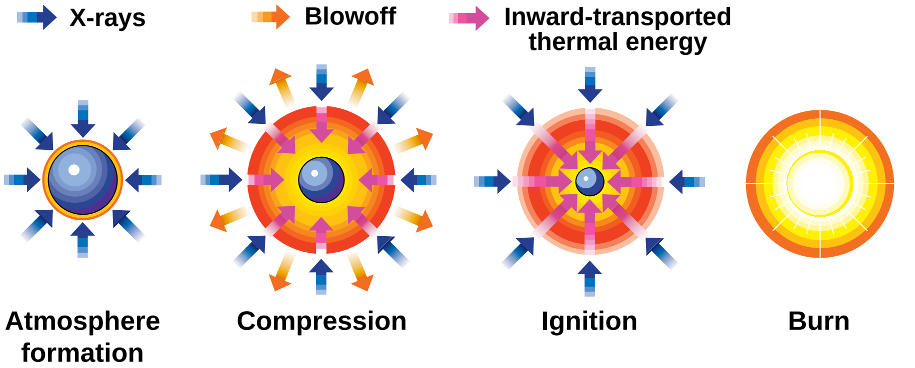
Fusion is the process of combining or "fusing together" two light nuclei, releasing energy. Energy from the Sun comes from a series of fusion reactions occurring at extreme temperature and pressure. NIF experiments will re-create these conditions in a process called *inertial confinement fusion*.



How fusion reactions produce energy

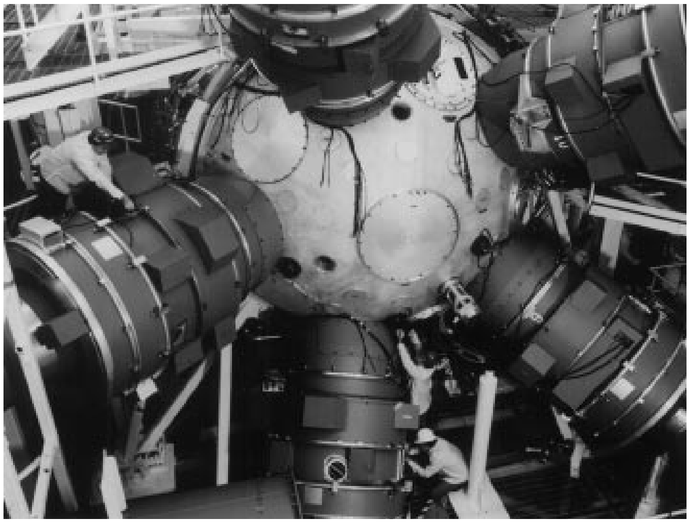


In inertial confinement fusion experiments, the laser beams shine through holes and strike the inside wall of a *hohlraum*, a small cylinder that holds a fusion capsule. Laser energy heats the inside of the hohlraum, creating X-rays that surround the capsule (or target).

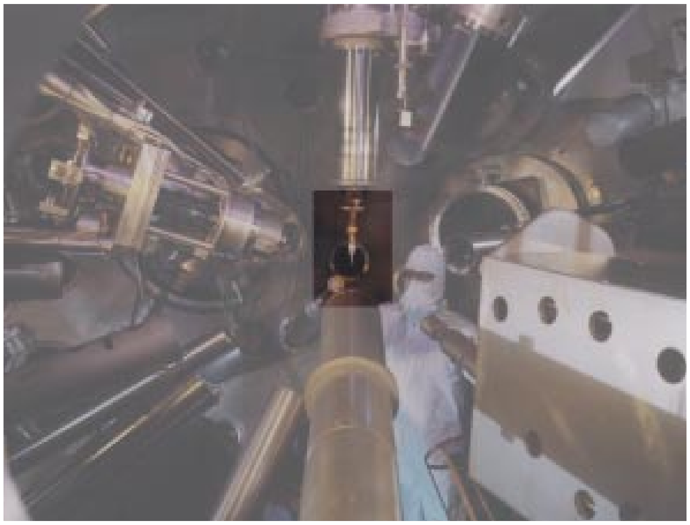


The X-rays rapidly (1) heat the capsule, (2) causing its surface to fly outward. This outward force causes an opposing inward force that compresses the fuel inside the capsule. When the compression reaches the center, temperatures increase to 100,000,000°C, (3) igniting the fusion fuel and (4) producing a thermonuclear burn that yields many times the energy input (energy gain).

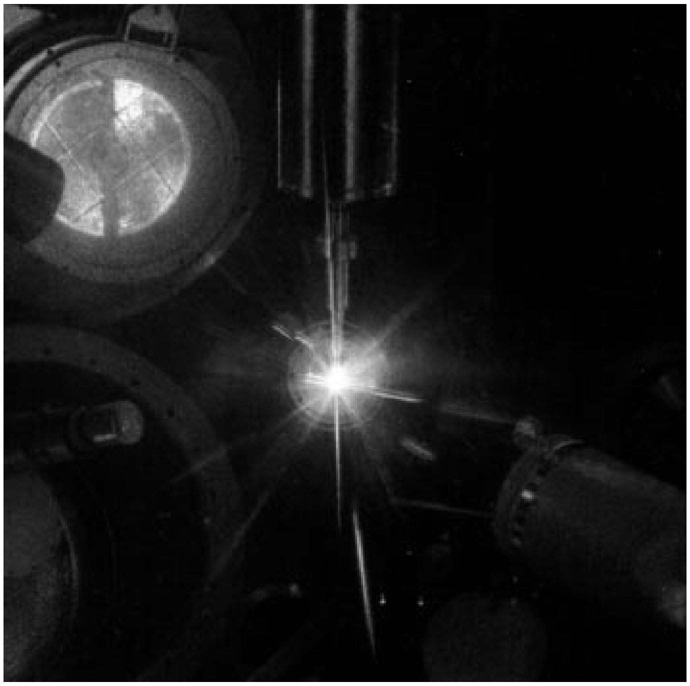
The Nova laser at Lawrence Livermore National Laboratory is the NIF's predecessor. In the Nova laser bay, the laser beams pass through these beam tubes to gradually build up their energy and power. Their total power is 100 times the total electric generating power of the United States (but only for one-billionth of a second!). The NIF will have 192 laser beams (compared to Nova's 10) and will produce 40 times more energy than Nova and 10 times more power.



The target chamber where Nova's laser beams are focused on a fusion target about the size of a grain of sand. The NIF target will be about four times as large (the size of a BB), so the compressed target will capture some of the fusion energy and ignite more fuel. This self-sustained process is called *ignition* and is the key to obtaining high energy gain in fusion targets.



Inside the target chamber, the fusion target is lowered on a vertical stalk. Instruments pointed at the target measure the laser's performance.

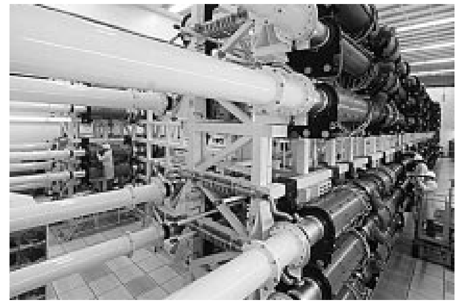


When the lasers fire and the target "burns" with fusion reactions, the temperature and pressure inside the target is the same as that inside the Sun. The tiny flash of light is, for one-billionth of a second, a tiny man-made star.

In Nova, fusion reactions occur, but ignition and energy gain are not obtained. In NIF, fusion ignition will occur and an energy gain of 1 to 10 times the input energy is expected.

Janus (1974)

Argus (1976)



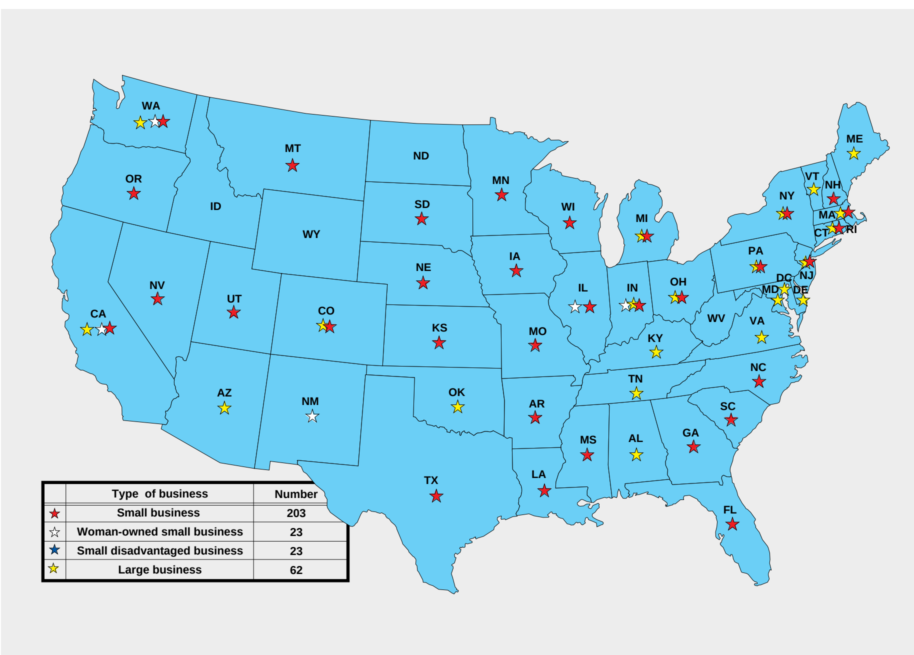
Shiva (1977)

Novette (1983)

Nova (1984)

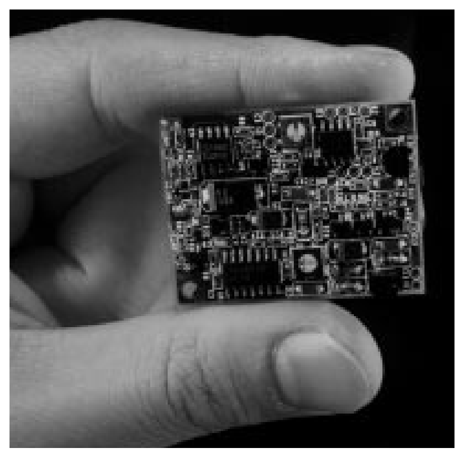
Beamlet (1994)

Lawrence Livermore National Laboratory has built six large laser facilities that have met their design, cost, and schedule goals. The Beamlet laser is a working scientific prototype of one NIF beamline.



	Type of business	Number
★ (red)	Small business	203
☆	Woman-owned small business	23
★ (blue)	Small disadvantaged business	23
★ (yellow)	Large business	62

As with previous inertial confinement fusion lasers, technology developed for the NIF will advance our industrial capability. Construction and manufacturing industries throughout the nation will receive more than three-quarters ($800 million) of NIF funds.



There are many technology spin-offs from inertial confinement fusion research. For example, several U.S. companies have licensed this “radar on a chip” technology originally developed to measure processes occurring in Nova experiments. This inexpensive and highly sensitive radar will have commercial applications in many key U.S. industries, including construction, automobile, security, and medical.

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